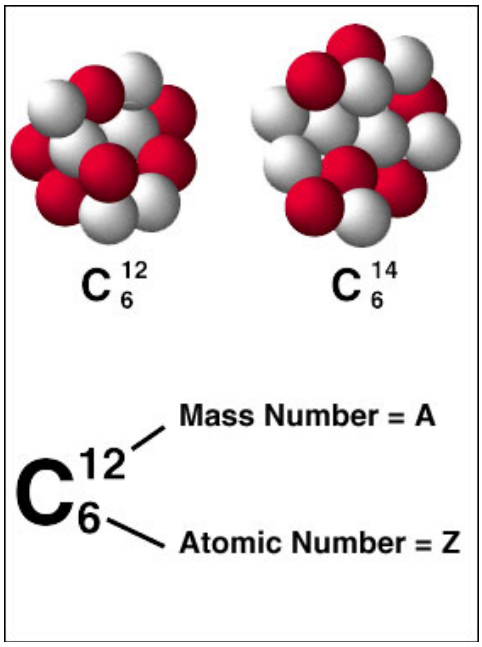
Nuclear Arithmetic



Over 100 elements have been discovered over the last century.

The nucleus of each atom contains two kinds of particles: protons and neutrons.

Scientists classify each element by the number of protons (Z) and the mass of the element (A).

Z is called the Atomic Number
A is called the Atomic Mass

The number of neutrons (N) in the nucleus is given by the formula:

$$N = A - Z$$

Problem 1 - In the above example for the element carbon, there are two different forms for carbon. A) How many protons are in the nucleus of Carbon-12 and Carbon-14? B) How many neutrons are in each nucleus?

Problem 2 - The element Praesodymium has an atomic number of 59 and an atomic mass of 141. How many nuclear neutrons does it contain?

Problem 3 - The element nickel (Z=28, A=58) has 30 isotopes that have the same atomic number, but whose atomic masses range from A=48 to A=78. A) How many neutrons does the lightest isotope of nickel have? B) How many neutrons does the heaviest isotope have?

Problem 4 - Solve the formula N = A - Z to determine the missing information:
A) Tin: A= 125 and Z=50 what is N?
B) Niobium: N = 54 and Z= 41 what is A?
C) Nobelium: A = 253 and N = 151 what is Z?
D) Francium: A=232 and Z= 87 what is N?
E) Oxygen: Z = 8 and N= 16 what is A?

Answer Key

Problem 1 - In the above example for the element carbon, there are two different forms for carbon. A) How many protons are in the nucleus of Carbon-12 and Carbon-14? Answer: Carbon-12 has Z=6 and so does Carbon-14 so they both have the same number of protons. B) How many neutrons are in each nucleus? Answer; The mass of Carbon-12 is A=12, while Carbon-14 has A=14 so Carbon-12 has 12-6 = 6 neutrons while Carbon 14 has 14-6 = 8 neutrons. Physicists call Carbon-14 an isotope of Carbon-14 for this reason.

Problem 2 - The element Praesodymium has an atomic number of 59 and an atomic mass of 141. How many nuclear neutrons does it contain? Answer: Z = 59 and A = 141 so N = 141-59 = 82.

Problem 3 - The element nickel (Z=28, A=58) has 30 isotopes that have the same atomic number, but whose atomic masses range from A=48 to A=78. A) How many neutrons does the lightest isotope of nickel have? B) How many neutrons does the heaviest isotope have? Answer; A) The lightest isotope is called Nickel-48 and has N = 48 - 28 = 20 neutrons. B) The heaviest isotope of nickel is called nickel-78 and has N = 78 - 28 = 50 neutrons.

Problem 4 - Solve the formula N = A - Z to determine the missing information:
A) Tin (A= 125, Z=50) N = ? Answer: N = 125-50 = 75
B) Niobium (N = 54, Z= 41) A= ? Answer: 54 = A - 41 so A = 54 + 41 = 95
C) Nobelium (A = 253, N = 151) Z = ? Answer; 151 = 253 - Z so Z = 253-151 = 102.
D) Francium (A=232, Z= 87), N=? Answer: N = 232 - 87 = 145.
E) Oxygen (Z = 8 N= 16) A=? Answer: 16 = A - 8 so A = 24.